DOCUMENT RESUME

ED 244 949 SP 024 436

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TITLE Performance Variability of Educable Mentally Retarded Boys on a Novel Kicking Task.
PUB DATE 30 Mar 84
NOTE 21p.; Paper presented at the Annual Convention of the American Alliance for Health, Physical Education, Recreation and Dance (Anaheim, CA, March 29-April 2, 1984).
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Cognitive Development; Elementary Education; Males; *Mild Mental Retardation; Motor Reactions; *Object Manipulation; Perceptual Motor Coordination; *Performance Tests; *Psychomotor Skills

ABSTRACT

Baumeister's (1968) hypothesis that mentally retarded children exhibit depressed levels of performance and greater intra-individual variability when compared to intellectually non-handicapped children of similar chronological age was investigated. Eight 10-year-old educable mentally retarded boys and 16 non-handicapped boys, matched by either mental age or chronological age, attempted 60 trials on a kicking task. Results indicated that mental age-matched boys exhibited greater variable error than did either the mentally retarded or chronological age-matched boys, while mentally retarded boys performed with greater, although not significant, error than did chronological age-matched boys. Significant correlations in early trial-blocks were found for constant error with variable error for mentally retarded and mental age-matched boys. These findings support the variability hypothesis in early task acquisition. (Author/JD)

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ED244949

Performance Variability of Educable Mentally Retarded Boys On a Novel Kicking Task

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March 1984

Presented at the National Convention of AAHPERD in Anaheim, CA, March 30, 1984

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Abstract

Baumeister's (1968) variability hypothesis was investigated in eight 10-year-old EMR boys and 16 normal boys matched on either MA or CA. Subjects attempted 60 trials on a novel kicking task. Results indicated that MA-matched boys exhibited greater variable error than either the EMR or CA-matched boys, while EMR boys performed with greater, although not significant, error than CA-matched boys. Constant error was observed to be greater for EMR boys than for either MA- or CA-matched boys. Significant correlations in early trial-blocks were found for constant error with variable error for EMR (blocks 1 and 2) and MA-matched (block 1) boys. These findings support the variability hypothesis in early task acquisition.

Performance Variability of Educable Mentally Retarded and Normal Boys on a Novel Kicking Task. March, 1984.

Introduction

Literature in motor learning and performance has consistantly shown that mentally retarded children exhibit depressed levels of performance and greater intra-individual variability when compared to intellectually normal children of similar chronological age (CA). Reaction time studies have evidenced that intra-individual variability (variable error, VE) contributes to a greater extent to the overall performance of the mentally retarded than for CA-matched normal children (Baumeister, 1968; Baumeister & Kellas, 1968; Berkson & Baumeister, 1977; Caffrey, Jones & Hinkle, 1971; Kellas, 1969; Weaver & Raveris, 1970). Baumeister (1968) has termed these observations the variability hypothesis.

Although greater VE and inferior levels of performance of educable mentally as compared to CA-matched normal children were evidenced by McGowan, Dobbins & Rarick (1973) on coincidence timing and by Dobbins & Rarick (1977) on throwing for accuracy these studies did not support Baumeister's hypothesis. Intellectually normal subjects matched on mentally age (MA) were not used in either of the above studies. This may be construed as a shortcoming since it could not be determined whether the greater VE was actually due to depressed cognitive function or to developmental and experiential trends in performance. Therefore, it would have been advantageous for both McGowan et al. (1973) and Dobbins and Rarick (1977) to have incorporated MA-matched normal comparison groups into their studies. In addition, results for throwing accuracy (Dobbins & Rarick, 1977) were based on a single mean score from 28 trials on both VE and |CE| (the absolute value of constant error). It would have been helpful to observe the VE and CE relationship over time since relative changes could have occurred which may have been masked by the utilization of a single mean score.

The purpose of this study was to investigate performance by educable mentally retarded (EMR) and non-retarded boys (matched on either MA or CA) on a novel kicking task. Moreover, this study sought to determine if possible differences in CE across trials could be due to possible differences in VE.

Method

Subjects

Eight EMR and 16 non-retarded boys were randomly selected from a larger pool of subjects from public schools in Southeastern Pennsylvania. Three groups of eight subjects each were formed: an EMR group, an MA-matched non-retarded group and a CA-matched non-retarded group. Table 1 includes both the CA and MA means and ranges for subjects' by group.

insert Table 1 about here

Apparatus

Both apparatus and protocol have been described elsewhere (Porretta, 1982) and therefore appear in abbreviated form. The apparatus was composed of a free-standing floor target, a bench of adjustable height and a sloped surface over which a ball could be rolled. The surface was constructed by placing wooden supports under the left side of slats of lumber then covered by Nissen mats over which green indoor/outdoor carpeting was placed so that a slope of 8 degrees was obtained. The target was composed of wooden frame on which 19 separate wooden panels were secured. The center panel, marked in red, was designated as the center or "bull's eye". Pressure of a kicked ball on a panel caused it to depress a microswitch, located directly behind the panel thus completing an AC circuit causing a light bulb directly above the panel to be illuminated providing visual reinforcement to the subject.

Procedures

The subject was seated on the bench facing the target at a distance of 5 meters. The sloped surface was located between the subject and the target. A reduced-size Nerf soccer ball was placed in a standard location in front of the toes of the subject's non-preferred bare foot. On the command "go" the subject rolled the ball over the surface to the target with a soccer-like in-step kick. The subject was encouraged to aim at the center of the target. Following each trial, subjects received a score of zero if the ball struck the center panel of the target, one if the ball struck the panel on either side of the center panel and so on up to a score of ten if the target was completely missed. Balls striking to the right of the center panel were assigned positive values while those striking to the left side of the center panel were assigned negative values. An interpolated score was given in the event two adjacent panels were struck simultaneously.

Results

Constant error (CE) and variable error (VE) from 60 performance trials were utilized as dependent measures for the initial analysis. CE is defined as the deviation score about the target with respect to sign while VE represents the variability of scores or the standard deviation of the subjects' CE scores. A split-unit analysis of the data was employed, with subjects considered the whole unit and group the whole unit factor; five blocks of 12 trials each constituted the split-unit factor. Examination of the group covariance matrices indicated the split-unit analysis to be appropriate (equality and circularity conditions met). Duncan's Multiple Range test was performed as a post-hoc procedure when significant main effects were found.

The split-unit analysis revealed significant main effects for each dependent measure. CE data analysis (Figure 1) yielded significant results for trial-block ($F=2.84$, 4/84 df, $p < .05$). Analysis of the main effect for trial-blocks of CE scores revealed that the mean for trial block 5 (-1.540) was significantly different ($p < .05$) from the means of trial-block 1 and 2 (-0.354, -0.760) respectively. All other comparisons failed to reach significance. Although the EMR group performed with a greater mean CE (-1.708) than either the MA-matched (-0.745) or CA-matched (-0.506) groups these values failed to reach significance.

insert Figure 1 about here

Subsequently, an analysis of absolute error (AE; scores without regard to sign) was employed since these results could provide a more meaningful behavioral construct of kicking performance (Porretta, 1982, Safrit, Spray & Diewert, 1980).

Thus, a 3 (group) X 5 (trial-blocks) analysis of variance with repeated measures on the second factor was employed and Duncan's Multiple Range Test used when significant main effects were found. Results from this analysis revealed significant main effects for group ($F=4.21$, 2/21 df, $p < .05$) and trial-block ($F=59.94$, 4/84 df, $p < .01$) (Figure 2). Main effect analysis for group revealed that the mean error performance (3.729) for the CA-matched group was significantly less in terms of AE than the mean error performance of (4.533) for the EMR or 4.657 for the MA-matched groups ($ps < .05$) respectively, whereas the EMR and MA-matched subjects performed similarly. Analysis of the trial-block main effect revealed that the mean performance (6.083) for trial-block 1 was significantly different ($p < .05$) from trial-blocks 2 through 5 (4.619, 3.854, 3.750, 3.225) respectively. The mean performance of trial-block 2 was significantly different

($p < .05$) from trial-blocks 3 through 5, while trial-blocks 3 and 4 were significantly different ($p < .05$) from trial-block 5.

insert Figure 2 about here

Split-unit analysis of VE scores yielded significant main effects for group ($F=5.68$, 2/21 df, $p < .05$), trial-block ($F=24.84$, 4/84 df, $p < .01$) and the group X trial-block ($F=2.89$, 8/84 df, $p < .01$) interaction (Figure 3). The analysis for the group main effect revealed a significantly greater mean VE (5.259) for the MA-matched group than the mean VE of 4.515 for the EMR or 4.225 for the CA-matched group ($ps < .05$, respectively), while the EMR and CA-matched groups performed similarly. As for analysis of the trial-blocks main effect the mean VE (6.038) for trial-block 1 was significantly different ($p < .05$) from trial-blocks 2 through 5 (4.839, 4.440, 4.335, 3.680) respectively. In addition, the mean VE (3.680) was significantly different ($p < .05$) from the mean scores of trial-blocks 2 through 4. All other comparisons failed to be significant.

insert Figure 3 about here

Figure 3 illustrates the group X trial-block interaction and shows that subjects decreased VE across trials. Developmental trends are evident, since the CA-matched group performed with less VE than the MA-matched group while the EMR group generally performed with less VE than the MA-matched group and greater VE than the CA-matched group.

In order to determine the relationship between VE and CE scores Pearson Product Moment Correlations were calculated for the dependent measures across the five trial-blocks for each group (Table 2). Significant correlations were obtained for trial-blocks 1 and 2 (.7312, .7379; $p < .05$) for the EMR group while one significant correlation was obtained for trial-block 1 (.7921; $p < .05$) for

the MA-matched group. No significant correlations were obtained for the CA-matched group.

insert Table 2 about here

Discussion

A significant main effect for trial-blocks for each of the three dependent measures (CE, AE, VE) revealed that all subjects were able to reduce error over trials. These results suggest that subjects were able to improve performance over repeated trials; a factor most important to motor skill learning.

Although a significant group effect for CE was not obtained, the EMR Group performed with greater CE than both the CA- or MA-matched Groups. The small number of subjects used in the study or perhaps the positive and negative scores cancelling each other could have explained the non-significant findings for group effects.

Analysis of AE produced significant main effects for group. Results again indicated that the EMR Group performed with greater error than the CA-matched Group while the EMR Group and MA-matched Group performed similarly. Previous research on motor performance of the mentally retarded (Rarick, Widdhop, and Broadhead, 1970; Francis & Rarick, 1959; Porretta, 1982) are consistent with present results.

Significant main effects for group on VE scores are consistent with previous research on motor performance of EMR subjects compared to normal subjects of similar CA. Of special interest is the large intra-individual variability of the MA-matched normal subjects since they performed with greater error than both the EMR and CA-matched groups. The large VE scores could have been due to the lack of experience by MA-matched subjects on kicking tasks or due to developmental trends in kicking performance

(Johnson, 1962). On trial-block 1 it was observed that the EMR group had a smaller VE score than either the CA- or MA-matched Groups (Figure 2). This seems to indicate that EMR subjects were consistently poorer in their performance in early trials than the other two groups, whereas both the CA- and MA-matched Groups may have fluctuated in performance (sometimes by accurately hitting the target close to the center and sometimes missing the target completely). It was apparent that in Trial-Block 2 the performance of both the CA- and MA-matched Groups became more stable whereas, the EMR Group's variability remained virtually unchanged.

Although not obtained in either the McGowan et al. (1973) or the Dobbins and Rarick (1977) studies significant correlations were found in Trial-Blocks 1 and 2 for the EMR subjects and Trial-Block 1 for the MA-matched subjects; indicating support for Baumeister's (1968) variability hypothesis. The non-significant results obtained from the McGowan et al. (1973) and Dobbins and Rarick (1977) studies could have been due to their failure to analyze the CE/VE relationship over specified time intervals. In both studies, the CE/VE relationship was obtained by way of a single mean score for each dependent measure which could have masked a relationship that may have existed. In addition, a typical overarm throw was used in the Dobbins and Rarick (1977) study and therefore results could have been due to experiential factors. Task novelty in this study attempted to take this into account.

Baumeister's (1968) hypothesis has been strongly supported in reaction time (RT) studies. It seems that the unpredictibility of stimulus presentations common to RT studies results in lower performance levels being attributed to large intra-individual variability. Results of this study, however, support

the variability hypothesis only in early trials. The relationship between CE and VE, therefore, is not likely to continue to exist when subjects are presented with stable environmental conditions during the learning of motor tasks over repeated trials.

To this investigator's knowledge prior to this experiment, Baumeister's hypothesis has been examined exclusively with EMR and CA-matched subjects. Results indicate that MA-matched subjects in this study may perform in a manner similar to EMR subjects for at least the first block of trials. It is known that EMR subjects perform cognitively in a manner similar to their normal MA-matched counterparts (Mercer & Snell, 1977). This similarity may extend to initial performance on novel gross motor tasks since novelty may bring into play a certain degree of cognition. Therefore, further research with other motor tasks is warranted.

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Figure 2. Mean absolute error scores for groups by blocks of trials.

Figure 3. Mean variable error scores for groups by blocks of trials.

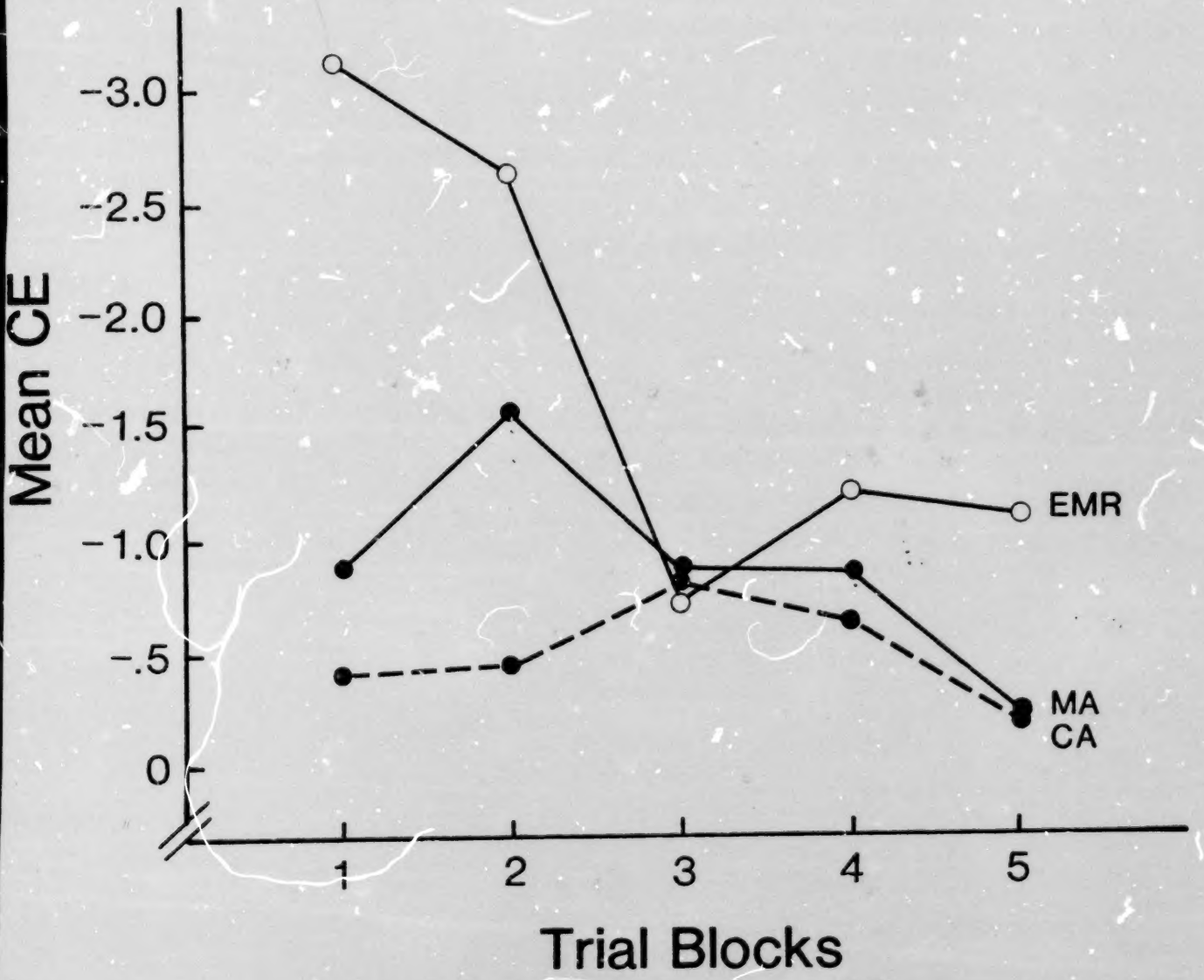
Group	CA*		MA*	
	Mean	Range	Mean	Range
EMR	10.2	9.8-10.5	6.6	6.1-7.1
MA-matched	6.5	6.0-7.1	6.5	6.0-7.1
CA-matched	10.0	9.8-10.5	10.0	9.8-10.5

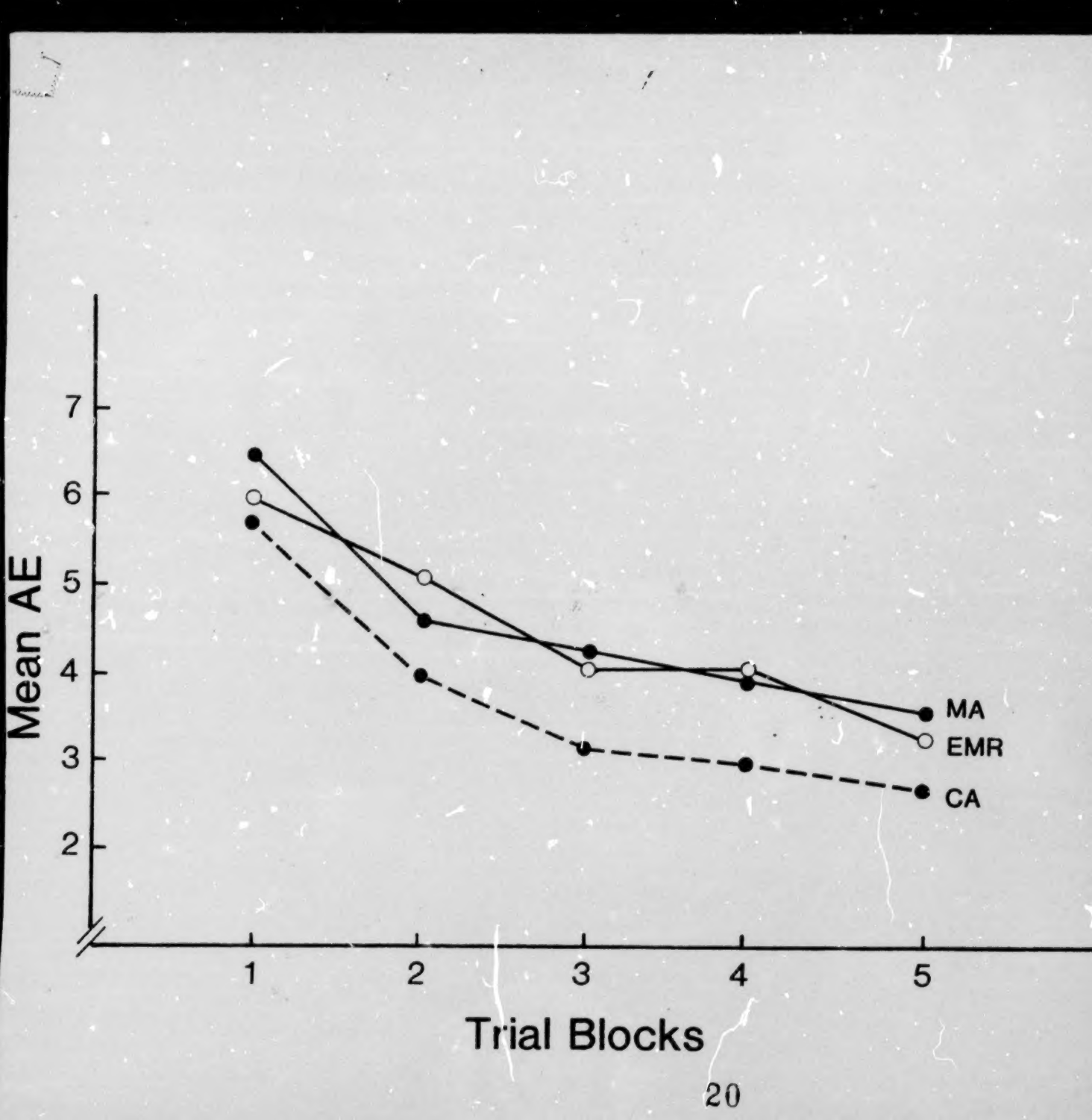
*In years

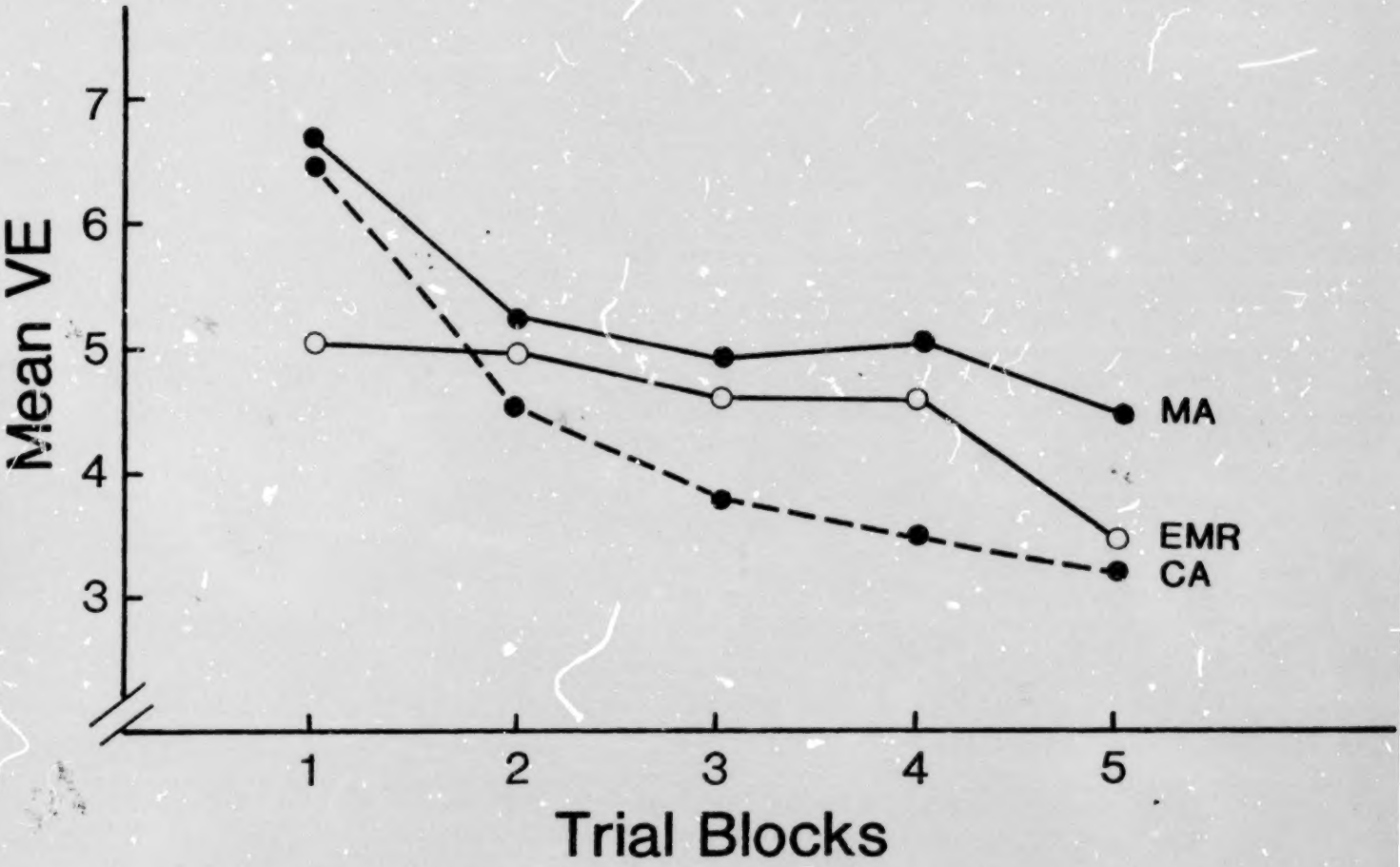
Trial Blocks

Group	Block 1	Block 2	Block 3	Block 4	Block 5
EMR	.7312*	.7379*	−.6032	.1164	.2095
MA-matched Norrnal	.7921*	.0043	.1082	.1617	.0724
CA-matched Normal	.1344	−.0639	−.2947	−.0837	.4639

*$p < .05$


Mean CE
-3.0
-2.5
-2.0
-1.5
-1.0
-.5
0
1
2
3
4
5
Trial Blocks
EMR
MA
CA


Mean AE
7
6
5
4
3
2
1
2
3
4
5
Trial Blocks
MA
EMR
CA


Mean VE
7
6
5
4
3
MA
EMR
CA
1
2
3
4
5
Trial Blocks